

APPLICATION FOR UNITED STATES LETTERS PATENT

5

FOR

10

**Method and Apparatus for Generating Structured
Documents for Various Presentations**

15

Inventor: Evan S. Huang
7634 Orange Blossom Drive
Cupertino, CA 95014
Citizenship: USA

20

Assignee: XMLCities, Inc.
1617A S. Main Street
Milpitas, CA 95035

25


Docket No.: 2276-02

Express Mail Label #EK806098897US; Date of Deposit: 01/05/2001

30

I hereby certify that this paper or fee is being deposited with the United States Postal Service using "Express Mail Post Office To Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to "Assistant Commissioner for Patents, Washington, DC 20231."

35

Name: Joe Zheng Signature: 

Method and Apparatus for Generating Structured Documents for Various Presentations

Evan S. Huang

CROSS-REFERENCE TO RELATED APPLICATION

5 This application claims the benefits of the provisional application, No. 60/179,330, entitled "Method and Apparatus for Generating Structured Documents with User-defined Document Type Definitions Using Structure-based Font Information", filed 1/31/2000, which is hereby incorporated by reference for all
10 purposes.

BACKGROUND OF THE INVENTION

Field of the Invention

15 The present invention generally relates to the area of document processing and electronic publishing systems and more particularly relates to a method and apparatus for generating structured documents with user-defined document type definitions. The present invention also relates to a mechanism provided to users to convert unstructured documents for various presentations
20 using the method and apparatus, wherein the unstructured documents are defined to be files composed, edited, or managed via an authoring application (e.g. word processing).

Description of the Related Art

The Internet is a rapidly growing communication network of interconnected computers around the world. Together, these millions of connected computers form a vast repository of hyperlinked information that is readily accessible by any of the connected computers from anywhere and anytime. With millions of web pages being created and added to this vast repository each year, there is a tremendous need to quickly and easily convert documents, such as presentations, data sheets or brochures, into a format presentable to and accessible by other applications or computers on the Internet.

It is well known that a preferable format that is presentable to a web browsing application (e.g. a browser) is in a markup language, such as HyperText Markup Language (HTML), Extensible Markup Language (XML), Standard Generalized Markup Language (SGML) or Wireless Markup Language (WML). Files or documents that are so composed, edited or managed for web browsing applications are commonly referred to as structured files or documents. Among all the benefits of the structured documents, the ability to provide user-defined document type definitions (DTD) or document schema definition opens a new paradigm for information exchange or storage. However, the challenge is how to generate structured documents with arbitrarily user-defined DTD.

An unstructured document with specific DTD can either be created from an unstructured document or converted from a

structured document with other type of DTD. There are several editors for generating structure documents. The exemplary editors include Adobe FrameMaker, Arbortext Epic, and SoftQuad XMetal. These editors usually provide a structural view along with a word processing view, where the word processing view is like the traditional word processing environment for unstructured document while the structural view contains the document structure of data elements defined in certain DTD. To create a structured document from scratch in these editors, a user usually needs to create an unstructured document in the word processing view. With a desired DTD loaded in, the user constructs a document structure tree in the structural view in accordance with document elements defined in the DTD. Typically, the user is engaged in procedures by copying-and-pasting or dragging-and-dropping the data elements from the created document into the document structure tree.

To convert a structured document with one DTD into another DTD in these editors, one needs to load in the structured document, to modify the tags and attributes of document elements from one DTD to another, and to shuffle the data elements or to parse new data elements associated with redefined document elements in the new DTD.

Among the procedures described above, the association between data elements and document elements is a crucial and effortful processing for creating or converting an unstructured or structured document into a structured document with specific DTD. Several approaches have been proposed to associate the data

elements and the document elements to simplify the generation of the structured document. For examples, a keyword extracting approach extracts a keyword representative of the document structure from an unstructured document and the keyword/text pairs are used as the association between document elements and data elements. A coordinate approach associates data elements with markup language tags in document elements by sorting the coordinates for coordinate documents. A logical structure approach analyzes the document structure by matching the predetermined patterns and parses the data elements based on the analyzed document elements. Nevertheless, none of the above approaches have considered using identifiers (e.g. font information) to associate the data elements and document elements. There is, therefore, a need for a generic approach to use the identifier information in user-defined document type definitions to associate data elements and document elements for generating structured documents.

In addition, the procedures required by the exemplary editors are somehow tedious and laborious and are inherently of high cost. Quite often, a business that has many documents to convert has to outsource the process due to the inefficiency and slowness associated with the conversion process. On the other end, the conversion process conducted by a service provider is difficult to be quantified as it is mainly involved in manual and repeated processes depending on the complexities of the documents. There is thus another need for a mechanism for quantifying the

SUMMARY OF THE INVENTION

5 The present invention has been made in consideration of the above described problems and needs and has particular applications to presentations over the Internet. One of the features in the present invention is the use of identifiers in a DTD file to associate selected objects or group objects so that association information of selected objects or group objects can facilitate the generation of files in a markup language suitable for presentations on various media.

10 The present invention may be implemented as a method, a system, a product or other practical forms. According to one implementation, the present invention is a method. The method receives a definition file including document type definitions (DTD) and displays a metafile along with the definition file, the metafile including a number of displayable objects and respective decoration attributes about each of the displayable objects. The definition file includes a structure for document elements, each corresponding to one of the displayable objects in the metafile.

15 Some of the document elements include a number of identifiers, each of the identifiers being assigned to one of the document elements. In one implementation, the identifiers are numerals and/or alphabets. In another implementation, the identifiers are one or more of a font name, a color name, a size, a font type, a color, a style, various effects or other symbols. The method associates at least one of the identifiers with one of the displayable objects.

20

25

According to another implementation, the present invention is implemented as a method for providing document conversion process, the method comprising activating a counter having a numbering system, converting an unstructured document into a metafile, wherein the metafile including a number of displayable objects and respective decoration attributes about each of the displayable objects, receiving a definition file including document type definitions (DTD) relating to the unstructured document; generating a modified metafile including association information of at least one of the displayable objects associated with one of the definitions in the definition file; and causing the counter to increment as soon as the modified metafile is to be saved.

Objects and advantage together with the foregoing are attained in the exercise of the invention in the following description and resulting in the embodiments illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

FIG. 1A shows a basic system configuration in which the present invention may be implemented in accordance with a preferred embodiment;

FIG. 1B shows internal construction blocks of a system in which the present invention may be implemented and executed to achieve desired results contemplated in the present invention;

FIG. 2A illustrates an example of an unstructured document that may be composed, edited or managed by an authoring tool.

FIG. 2B is an example of document type definitions (DTD);

FIG. 2C shows a structured document for the unstructured document shown in FIG. 2A based on the document type definitions (DTD) in FIG. 2B;

FIG. 3A illustrates a functional diagram according to one embodiment of the present invention;

FIG. 3B shows a visual environment implementing a conversion module according to one embodiment of the present invention;

FIG. 3C shows an example of a style sheet designed in XML format with respect to displayable objects in a metafile shown in FIG. 3B;

FIG. 3D shows an exemplary message from a dongle;

5 FIG. 3E shows a process flowchart of using a product including an implementation of conversion module according to one embodiment of the present invention;

10 FIG. 4 illustrates a block diagram of data processing apparatus which imports, edits, and converts unstructured or structured document into structured documents with user-defined DTD using structure-based font information;

FIG. 5 is an association table for document elements defined in DTD in FIG. 2B and font attributes;

15 FIG. 6 shows an editing result for the unstructured document in FIG. 1, where each parsed data element has been assigned font attributes based on the association table in FIG. 5;

FIG. 7 shows a transformation process which converts the parsed data elements in FIG. 6 into the desired structured document with the exemplary DTD in FIG. 2B;

20 FIG. 8 is an intermediate structured document, which contains parsed data elements with assigned font IDs associated with a list of font document elements;

FIG. 9 shows a transformation process which converts the intermediate structured document in FIG. 6 into the desired structured document with DTD in FIG. 2; and

5 FIG. 10 shows an implementation of the transformation process in FIG. 9 using the extensible style language for transformation (XSLT).

DETAILED DESCRIPTION OF THE PREFERRED
EMBODIMENTS

In the following detailed description of the present invention, numerous specific details are set forth in order to provide a
5 thorough understanding of the present invention. However, it will become obvious to those skilled in the art that the present invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and circuitry have not been described in detail to avoid unnecessarily obscuring
10 aspects of the present invention. The detailed description is presented largely in terms of procedures, logic blocks, processing, and other symbolic representations that directly or indirectly resemble the operations of data processing devices coupled to networks. These process descriptions and representations are the
15 means used by those experienced or skilled in the art to most effectively convey the substance of their work to others skilled in the art.

Reference herein to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic
20 described in connection with the embodiment can be included in at least one embodiment of the invention. The appearances of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other
25 embodiments. Further, the order of blocks in process flowcharts or diagrams representing one or more embodiments of the invention

do not inherently indicate any particular order nor imply any limitations in the invention.

Referring now to the drawings, in which like numerals refer to like parts throughout the several views. FIG. 1A shows a basic system configuration in which the present invention may be implemented in accordance with a preferred embodiment. Unstructured documents, such as product descriptions, functions lists and price schedules, may be created using an authoring tool executed on a computer **100**. Files or Documents created by an authoring tool are referred to as unstructured documents. Exemplary authoring tools may include Microsoft Office (e.g. Microsoft Word, Microsoft PowerPoint, and Microsoft Excel), Adobe FrameMaker and Adobe Photoshop. The unstructured documents may be uploaded to computing device **102** that may serve as a central repository. Computing device **102** may be a server station from Sun Microsystems (www.sun.com) or a desktop computer loaded with a compiled and linked version of one embodiment implementing the present invention.

In one setting, computer **100** and computing device **102** are inseparable and perform document conversion process and generate structured documents that may be ultimately represented in a format of markup language such as XML or HTML. In one application, the structured documents represented in XML are converted to HTML format and become available through a private network **110** to a service server **104** that hosts what is generally referred to as a www (world wide web) site.

In one situation, a user uses a desk computer **106** that operates a browsing application and is coupled to data network **108** to access files on service server **104**. These files represented by the structured documents in computer **102** may represent the latest product information originally composed via an authoring tool.

As will be explained below, the present invention is not limited to the Internet applications. It may be practiced in individual computers in which users often create documents in different word processing formats, such as FrameMaker or Microsoft Word. The present invention may be utilized to convert documents to a markup representation regardless of the exact word processing formats.

FIG. 1B shows an internal construction blocks of a system **118** in which the present invention may be implemented and executed. System **118** may correspond to a client device (e.g. computer **100**, **102** or **106**) or a server device (e.g. server **104**). As shown in **Figure 1B**, system **108** includes a central processing unit (CPU) **122** interfaced to a data bus **120** and a device interface **124**. CPU **122** executes certain instructions to manage all devices and interfaces coupled to data bus **120** for synchronized operations and device interface **124** may be coupled to an external device such as computer **102** hence documents therefrom are received into memory or storage through data bus **120**. Also interfaced to data bus **120** is display interface **126**, network interface **128**, printer interface **130** and floppy disk drive interface **138**. Generally, a compiled and linked version of one embodiment of the present invention is loaded into storage **136** through floppy disk drive

interface **138**, network interface **128**, device interface **124** or other interfaces coupled to data bus **120**.

Main memory **132** such as random access memory (RAM) is also interfaced to data bus **120** to provide CPU **122** with the instructions and access to memory storage **136** for data and other instructions. In particular, when executing stored application program instructions, such as the compiled and linked version of the present invention, CPU **122** is caused to manipulate the data to achieve results contemplated by the present invention. ROM (read only memory) **134** is provided for storing invariant instruction sequences such as a basic input/output operation system (BIOS) for operation of keyboard **140**, display **126** and pointing device **142** if there are any.

FIG. 2A illustrates an example of an unstructured document **200** that may be composed, edited or managed by an authoring tool. In an unstructured document, data is generally presented in sequence, which usually follows a reading order (e.g. from top to bottom and left to right). This sequence may be parsed into segments of data elements, where each data element **102** is assigned with decoration attributes or information such as positions, font color, font size, font type, style and various effects and etc. The decoration information is essentially for proper layout and presentation purpose when a file containing the data elements is opened by the authoring tool for display on a display screen.

According to one embodiment, an unstructured document is printed to a metafile format that contain the decoration information. An example of a metafile format is commonly used Portable Data Format (PDF). One of the advantages of the metafile format is its independence from the authoring tool and perhaps from computers so that the metafile format can be opened or read identically in many different environments.

A structured document such as SGML and XML starts with document type definitions (DTD). FIG. 2B illustrates an example of DTD **208** for “recipe-type” documents, in which a document is to be broken down into structures of document elements. A particular document element **210** may contain other document elements and attributes. Another example of the document element **212** contains only the parsed character data.

FIG. 2C shows structured document **220** converted correspondingly from unstructured document **200** in FIG. 2A with respect to DTD **208** in FIG. 2B. As shown in the figure, the data sequence in the unstructured document is parsed into data elements associated with document elements defined in DTD for the structured document.

Unlike the unstructured document, the structured document can easily access certain information via the document elements. Presentation of a structured document is usually defined in separate style sheets, e.g., written in cascading style sheet (CSS) or extensible style language for formatting objects (XSL-FO), which

interprets layout for each document element. This feature allows a structured document to be presented in different layouts for different media through different style sheets. Generally, the decoration information or formatting attributes, such as font information in an unstructured document, unless defined in DTD as attributes of document elements, abandoned after an unstructured document is converted into a corresponding structured document. Further modification of formatting information will in general not affect the converted structured documents.

FIG. 3A illustrates a functional diagram **300** according to one embodiment of the present invention. A conversion module **302** comprises an association module **302** and an integration module **306**. Association module **302** receives an unstructured document, preferably in a metafile format. At the same time, association module **302** also receives a file, referred to as a definition file, including DTD that are predefined. Generally, DTD is defined according to the nature or purposes of the unstructured document. For example, the unstructured document is in a category of receipts, e.g. document **200** in FIG. 2A, the DTD in a definition file as shown in FIG. 2B is designed in accordance to the “receipt-type” documents.

To further understand association module **302**, FIG. 3B shows an environment **320** implementing conversion module **302** according to one embodiment of the present invention. Environment **320** includes two displays **322** and **324** for a user to perform a conversion of an unstructured document to a file in

markup language (referring to a markup language file). Display **322** is used to display the unstructured document. In one preferable embodiment, a metafile version of the unstructured document is loaded for display. A metafile, referring to either the unstructured document or a printed version thereof, typically contains many displayable objects. Each object is a cluster or a group of characters or words or a graphic representation. As shown in display **322**, each word or an isolated numeral is a displayable object which is inherently carried over in the metafile. In other words, each object is defined by a number of attributes or decoration information including, but not limited to, type, size, color and position of the object such that it can be “printed” correctly. A number of objects can be grouped manually by a user in terms of their meanings or purposes. For example, group object **326** includes three character-type objects “Green”, “Chili” and “Salsa”. Naturally the three character-type objects forms a title as a group object **326**. The object grouping may be performed for the rest of the displayed metafile in display **322**.

Display **324** is used to display a definition file prepared for the metafile in display **322**. To facilitate operations of association module **302**, the definition file is presented graphically as “DTD Pool” **328**. For example, the graphical representation **328** of DTD **208** in FIG. 2B is used in display **324** to illustrate the hierarchical relationships among the document elements.

Accordingly to one embodiment that ultimately converts the metafile to an XML file, an auxiliary XML tree **330** is produced from

“DTD Pool” **328**. Auxiliary XML tree **330** also shows the hierarchical relationships among the document elements. In addition, each of the document elements is assigned to an identifier that may include, but not be limited to, a numeral, a name, a font, a type name or a color. In one embodiment, the identifier is in “data” of each of the document elements. To associate group object **326** with a document element “title” **332**, “data” **334** is activated upon group object **326** is selected. One of the features in the present invention is an underlying association that relates group object **326** with the identifier in “data” **334**. Specifically in one embodiment, if the identifier in “data” **334** is a color, “green”, group object **326** is highlighted in green to indicate that this group object has been associated with the DTD. If the identifier is a font, “Arial”, group object **326** is highlighted in style Arial to indicate that this group object has been associated with the DTD.

Similarly, a group object **340** can be associated with an identifier in data **342** under “ingredient”, a group object **344** can be associated with an identifier in data **346** under “amount” of “ingredient” and so on. As a result, the metafile in display **322** has been segmented and the displayable objects therein are respectively grouped and each of the group objects is associated with the document element in the loaded DTD by an identifier. Display **322** now has a modified metafile **310**, an example of which will be illustrated below.

Referring now back to FIG. 3A, modified metafile **310** is input to an integration module **306** that further receives a style sheet. A

style sheet is typically configured to include mapping rules in accordance of the media on which the objects from the metafile will be presented. One exemplary media is a web presentation of a file accessible by a browser (e.g. Internet Explore from Microsoft).

5 Hence, the file is in markup language, such as HTML or XML, referring to as a markup language file.

FIG. 3C shows an example of such style sheet designed in XML format with respect to the displayable objects in the metafile. Generally a style sheet is designed to position, color or size
10 respectively each of the objects so that a proper and attentive presentation can be achieved for a particular media. The example in FIG. 3C is designed for presenting "receipt-type" document and causes the modified metafile to generate a proper XML file when loaded. In other words, integration module **306** generates the XML
15 file from the modified metafile in accordance with the style sheet. Given the description herein, it can be noted that a style sheet does not have to be input to integration module **306**. In one implementation, the mapping rules can be loaded in with the DTD file so that integration module **306** performs mapping from the
20 modified metafile to a markup language file in accordance with the loaded mapping rules.

According to one embodiment, conversion module **302** is implemented in software and may be distributed as an application to users or service providers. It is understood that the conversion
25 process from an unstructured document to a markup language file is difficult to be quantified in a cost-determinable way. A counter

308 is included in conversion module **302**. In one embodiment, counter **308** is configured to count the number of pages in the metafile to be converted. Every time, all of the objects in a display (i.e. a page display) are associated with the document elements in a DTD file and saved as a corresponding modified metafile, counter **308** increments. FIG. 3D shows an example of counting results kept in a dongle. A dongle (pronounced DONG-uhl) is a mechanism for ensuring that only authorized users can copy or use a specific software application, especially very expensive programs. Common implementations of a dongle include a hardware key that plugs into a parallel or serial port on a computer and that a software application accesses for verification before continuing to run; special key diskettes accessed in a similar manner; and registration numbers that are loaded into some form of read-only memory at the factory or during a system setup.

When the dongle needs to be reset, the conversion process can be evaluated in a cost-determinable way. According to one embodiment, an owner of a product including an implementation of conversion module **302** may distribute the product free or at very low cost to users. Typically the user needs to produce volumes of web pages from the unstructured documents composed, edited or managed by various authoring tools. One of the benefits for the user to receive the product in such manner is not to have to come up with a large capital for acquiring the product before using it. The users may pay for the usage of the products. Hence, one of the purposes of using a dongle with conversion module **302** is to

manage the usage thereof. As a result, the owner of the product can control the usage of the product by controlling the dongle containing the usage information.

FIG. 3E shows a process flowchart **370** of using a product including an implementation of conversion module **302** according to one embodiment of the present invention. Some time, the product is leased by a user or a business. Other times, the product is used by a service provider providing services to businesses that need to convert unstructured documents to structured documents for different media presentation (e.g. presentation on a web site).

Process **370** starts with generating metafiles from authored documents at **372**. Generally, the authored documents may have been prepared using one or more authoring tools. As described above, metafiles are preferably obtained from the authored documents so that conversion module **302** does not have to be respectively configured for each of the different authoring tools. However, it should be noted that the preference of a metafile is not an inherent limitation to the current invention but is to make the product or conversion module **302** work more efficiently. Those skilled in the art understand that a conversion interface or a print driver could be configured to accommodate any type of the authored documents or generate the metafiles.

Once the metafiles are obtained, they may be now loaded to a visual environment in which the metafiles can be respectively displayed. Environment **320** of FIG. 3B may be applicable so that

pages of each of the metafiles can be individually loaded for display.

Before process **370** permits a user to proceed further, an authorization process **378** is triggered to ensure that the user is operating an authorized product. As described above, one exemplary authorization method is through a dongle that is pre-set by a business or a dealer that offers/owns/controls the product. If authorization process **378** indicates that process **370** is not authorized, typically a display is shown to the user as to where the product can be authorized. One of the procedures in setting authorization **376** involves a purchase of a permitted quantity for the number of pages converted or saved.

According to one embodiment, a dongle is used for coupling to a computer executing process **370**. The dongle includes a first and a second number. The first number is a starting number, for example, "10", and the second number is a limit number, for example, "1000", which means there are 1000 pages of converted documents can be processed and saved by process **370**.

Once process **370** is permitted to proceed to **380**, the user is now permitted to group a number of displayable objects respectively to group objects according to, perhaps, their meanings or their purposes and in view of a DTD file loaded and display nearby. At **382**, the group objects can be respectively associated with definitions in the DTD. At least some of the definitions have a

number of identifiers, preferably each identifier is associated or designated to one of the definitions.

As described above, the associations between the selected objects and the definitions are to be saved in a modified metafile.

5 Before process **370** permits such saving, an counter is to be checked at 386. In one embodiment, the first and the second numbers in dongle are compared. When the first number is substantially close to the second number, for example the two numbers being the same, process **370** will ask for a replenishment
10 of the permitted usage. Typically, the user has to get the dongle reset or reconfigured by a business or a dealer that can now collect fees based on the information in the dongle. At **384**, the numbers have been reset and now permit process **370** to proceed.

At **386**, a save step can be conducted. Depending on an
15 exact implementation, the modified metafile or a markup language file can be saved in a storage space. The markup language file is generated from the modified metafile in reference to a style sheet for a predefined media presentation. At **388**, the counter is incremented.

20 If should be noted that the counter is checked at **386**, in particular after **384**, in FIG. 3E. In fact, the description has made it evident to those skilled in the art that the counter could be checked or consulted virtually anywhere along process **370**. One of the objectives for using a counter herein is to facilitate a business to

control and determine the usage of process **370** so that a cost could be determined and a fee could be charged.

FIG. **4** shows a functional block diagram **400** of a data processing module **404** according to one embodiment of the present invention. Data processing module **404** included in integration module **306** comprises an input module **406**, an editing module **410** and a transformation or filtering module **414**. One of the functions performed by data processing module **404** is to convert unstructured documents or structured documents with different DTD into corresponding structured documents with pre-defined or specific DTD.

Input module **406** loads documents or imports documents from a document database **402** that may correspond to a repository in computing device **102** of FIG. 1A. Alternatively input module **406** can start a new document **408**. It should be noted that the loaded or imported documents, can be either unstructured (e.g. a metafile) or structured and may have contained pre-created structure-based font information in certain cases.

An editing module **410** communicates with input module **406** and creates/edits the structure-based font information for the input documents. This module allows selections of data elements for the input documents and provides an editing environment to alter the font attributes such as font type, font style, font color, font size, and font effects for the selected data elements. The way to parse the input documents into data elements and to assign font attributes is

based on an association table for the document elements defined in a desired DTD and associated font attributes **412**. An exemplary association table **500** for DTD **412** is given in FIG. 5, which contains fields of document element **502**, element attribute **504**, font type **506**, font style **508**, font color **510**, font size **512**, and font effect **514**.

FIG. 6 shows an editing result **600** for the unstructured document **200** of FIG. 2A. Each parsed data element or combined objects **602**, **604**, **606**, **608**, **610**, **612** and **614** has been assigned font attributes based on the association table in FIG. 5 and displayed respectively in the associated font. During the parsing, this module allows sequence selections of data elements based on the reading order of the input document **602** to edit their font information. This module also allows region grouping of data elements to edit their font information. This module can also provide an auxiliary view of the association table.

Transformation or filtering module **414** converts the loaded documents into structured documents with user-defined document type definitions (DTD) using the structure-based font information. Mapping rules based on the document elements and font attributes for the conversion **416** is imported or designed in this module.

FIG. 7 illustrates an example **700** of the mapping rules for converting the edited document **602** into the structured document **220** of FIG. 2C. In particular, **702** starts and **718** ends the “document” element, **704** starts and **714** ends the “recipe”

document, **706** forms the “ingredient” element, **708** forms the
“procedure” element, **710** forms the “presentation” element, and
712 forms the “originate” element. In **704**, **706**, **708**, **710**, and **712**,
the structure-based font information is used to locate the data
elements and the located data elements are assigned as attributes
or parsed character data for document elements. These mapping
rules can be implemented, by not restricted to, programming
languages such as Java, JavaScript, extensible style language for
transformation (XSLT), C/C++,...etc, or any build-in or
programmable hardware devices. The converted documents can
be either saved as a file document or exported into a document
database **418**.

Other than directly converting into the desired documents,
the transformation module can also output the edited documents as
the intermediate structured documents which contain the structure-
based font information. The intermediate structured documents
can be reloaded for further editing or batch conversion.

An example of the intermediate structured document **808** for
the edited document **600** is given in FIG. 8, where **802** contains
“font” elements with specific font attributes and **804** contains the
parsed data elements with “font_ID” attributes to associate the font
information. Since the parsed data elements with the same font
attributes have been grouped by the same “font_ID” in the
intermediate structured documents, mapping rules for conversion
can be designed based on the grouped font information.

FIG. 9 illustrates an example of the mapping rules for converting the intermediate document **800** into the structured document **220**. In particular, **902** starts and **918** ends the “document” element, **904** starts and **914** ends the “recipe” document, **906** forms the “ingredient” element, **908** forms the “procedure” element, **910** forms the “presentation” element, and **912** forms the “originate” element. In **904**, **906**, **908**, **910**, and **912**, the grouped font information is used to locate the data elements and the located data elements are assigned as attributes or parsed character data for document elements.

FIG. **10** shows an example of implementing the mapping rules given in FIG. **9** using the extensible style language for transformation (XSLT).

The invention described above is preferably implemented in software, hardware or a combination of both. At least portions of the invention can be embodied as computer readable code on a computer readable medium. The computer readable medium is any data storage device that can store data that can be thereafter read by a computing device. Examples of the computer readable medium include read-only memory, random-access memory, disk drives, floppy disks, CD-ROMs, DVDs, magnetic tape, optical data storage devices, carrier waves. The computer readable media can also be distributed over network coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

The present invention has been described in sufficient detail with a certain degree of particularity. It is understood to those skilled in the art that the present disclosure of embodiments has been made by way of examples only and that numerous changes in the arrangement and combination of parts may be resorted to without departing from the spirit and scope of the invention as claimed. While the embodiments discussed herein may appear to include some limitations as to the presentation of the information units, in terms of the format and arrangement, the invention has applicability well beyond such embodiment, which can be appreciated by those skilled in the art. Accordingly, the scope of the present invention is defined by the appended claims rather than the forgoing description of embodiments.